HUSBANDRY

Spiny-tailed Iguanas: Captive Care[1]

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Acquisition and Acclimation

A number of factors must be considered before acquiring a Spiny-tailed Iguana (*Ctenosaura* spp.), the most important of which is making the long term commitment involved in caring for a lizard that can survive 20 years or more. Since the survival and health of the iguana is completely dependent on the quality of care provided by the owner, he or she must consider future changes in his or her own life and the necessary accommodations that must be made to properly maintain these animals. Some species grow very large (over 1 m in total length), although others remain small (less than 25 cm in total length). Potential owners must recognize that a hatchling of one of the larger species can grow to a meter in length within 2–3 years and will require very roomy quarters.

A qualified reptile veterinarian experienced in iguana care should be located to provide general health checks as well as emergency services, should those be required. Provision also must be made for an alternate caretaker should the owner be away or unable to provide care. Accurate records should be kept

[1] Adapted and expanded from Köhler, G. 2002. *Schwarzleguane. Lebensweise, Pflege, Zucht.* Herpeton Verlag Elke Köhler, Offenbach, Germany. Most changes reflect the different realities of European and North American ctenosaur husbandry. Different products necessary for proper care are available and, although several species are commonly kept in Europe, most Americans keep only *Ctenosaura similis*, a large and frequently aggressive form.

Ctenosaura nolascensis is long-lived and can become large. Prospective owners must give consideration to providing an enclosure of sufficient size and care for an extended period of time. *Photograph by John Binns.*

An outside view of an enclosure's UV-transmittable window and one happy iguana. A "room with a view" and sunlight does wonders for captive animals. *Photograph by John Binns.*

Terry-cloth towels are useful in handling less manageable animals by reducing the need to tightly clutch the animal. This reduces the stress of handling and the towel provides protection from the Spiny-tailed Iguana's sharp spines and barbed tail. *Photograph by John Binns.*

This simple display uses beach wood, artificial plants, fake cement stone, and corrugated tubing (hidden). The beach wood was arranged to provide multiple basking spots and careful stacking of parts ensured that they would not collapse. The feeding dish and water bowl are to the left of this photograph. *Photograph by John Binns.*

for each animal, including weights, measures, diet, and emergency telephone numbers.

Spiny-tailed Iguanas and Green Iguanas (*Iguana iguana*) differ in their captive care requirements. Ctenosaurs have a very different disposition than Green Iguanas, although this is a generalization and temperament will vary from one individual to another. One of the reasons for the popularity of Green Iguanas is their predominantly friendly and sociable nature; most animals will become quite tame over time with proper handling and care, and (with reasonable precautions) are easily handled, much like any "normal" house pet. In contrast, certain species of Spiny-Tailed Iguanas can be quite wild and difficult to manage. Tremendous patience and effort may be required in order to modify the behavior of such an animal. Some of the smaller species may be easier to work with, but only rare individuals will become sufficiently tame that they can be taken out of their enclosures. The chances for successfully taming an individual are much better when dealing with juveniles than with subadults or adults.

Spiny-tailed Iguanas produce relatively small, hard, dry fecal pellets, whereas Green Iguanas will excrete a far greater volume of solid waste, not to mention a considerable amount of fluid. For this reason, a Green Iguana habitat, out of necessity, must be easy to clean, and its aesthetic appeal can be no more than a secondary consideration. In contrast, an attractive natural environment can be created for a Spiny-tailed Iguana with less concern for hygienic problems or overpowering odors. Still, the enclosure should be designed to facilitate regular maintenance, especially when keeping larger Spiny-tailed Iguanas, which are prone to rearranging their cage furnishings. Changes in fecal consistency from a relatively dry to moist/runny deposits suggest a dietary imbalance or improper thermal gradient within the enclosure.

The time commitment for one male and one or two females will be a minimum of 30–60 minutes a day (food preparation, cleaning food and water dishes, and general maintenance). If problems arise (incompatibility or illness) or if the animals are breeding (egg laying, incubation, hatching), the time commitment increases accordingly, particularly if any of these situations require the setup and maintenance of extra enclosures.

These paired *Ctenosaura acanthura* often share the same basking spot and are rarely apart. *Photograph by John Binns.*

A number of ctenosaur species have been bred successfully in captivity, some with regularity and others less frequently. In any case, acquiring captive-bred animals is always preferable. Acquiring wild-caught animals only encourages the importation and exploitation of iguanas and limits the chances of the species' long-term survival in their natural habitats. Wild-caught animals are highly stressed, frightened, often ill (particularly due to heavy parasite loads), and their chances for survival are minimal. This is compounded by their fearful and flighty nature, resulting in a reluctance to eat and a host of other problems. Of those that do survive, all will remain wild and their life expectancy will be greatly shortened. Although captive-bred animals are not always parasite-free, they are considerably more stable, primarily due to having had fewer negative encounters with humans. Their behavior likely will be calmer and more trusting. Nevertheless, juveniles inevitably will acclimate more quickly than adults.

The territorial nature of Spiny-tailed Iguanas needs to be considered when deciding the number of animals to place in a single enclosure. Sex is not easily determined in very young ctenosaurs and, although a male and a female or a pair of young females are more likely to be compatible, and two males will definitely fight, no combination of numbers or sexes will assure that the animals will co-exist without some altercations. The size of the enclosure (generally "bigger is better") may be the deciding factor in providing sufficient territory for more than one animal. Introduction of animals into their new enclosure requires close observation to ensure compatibility. Dominance develops at a very young age, and can range from establishing a natural pecking order to violent biting and life-threatening aggression. A second enclosure must be available should the dominant animal create an unhealthy, irresolvable situation with its mate or other female animals in the enclosure.

On the positive side, competition for food may encourage others in the group to eat more than they would if they were held alone. A bolder and more curious individual may prompt others in the group to behave likewise, thus creating a healthy environment. Continuous monitoring of the behavior of either an individual or a group of animals is a key element of good husbandry.

Several tips may facilitate acclimation: (1) The habitat should be elevated so that the animals are at eye level with their caretakers. (2) Enclosures that open only at the top, such as refurbished aquaria, are ill-suited for iguanas. Many natural predators of young iguanas' (raptors!) attack from overhead, thus they instinctively fear anything coming from above. (3) The habitat should ultimately be set up in a high-traffic area as this helps to acclimate the animals to the presence of humans, making interaction with their caretakers less stressful. However, allowing 2–3 weeks after quarantine for the animals to first acclimate to their new habitat and/or new companions in order to reduce the high stress of translocation may be beneficial before they are moved to a more active area. Children should be cautioned not to handle or irritate the iguanas (e.g., by banging on the glass). (4) Owners should take time daily to tend to the animals while both animals and owner are calm and relaxed. Sit by the habitat and just observe them. The animals, in turn, will be able to observe their caretaker while at a safe distance. After a few days, when you feel that the iguanas have become somewhat accustomed to your presence, you can carefully slide open the enclosure and determine if further interaction is feasible. Some animals can be handfed without any difficulty, but others will be just as prone to attempt an escape or bite an intrusive finger.

Even if the new owner is experienced in iguana husbandry, newly acquired iguanas should be thoroughly examined by a qualified reptile veterinarian and quarantined until results of the examination are known and any required treatments have been successfully completed. This must precede any introduction into an enclosure with other animals. This examination typically entails a blood test, a fecal sample to determine if parasites are present, and a check for mites and ticks, injuries, swellings, and skin lesions. The results of the series of tests will determine the overall health of the animal and, should treatment for illness or parasites be required, the veterinarian will either suggest regular visits to administer the medication and treatment, or provide you with detailed instructions for treatment at home. Some types of parasites are fairly easy to eliminate, but for others, treatment can be expensive and lengthy, and the medications are not always well-tolerated by the animal. To determine if the parasite treatment was successful, the veterinarian must rerun the parasite test (fecal sampling). The veterinarian can provide guidance regarding the necessary quarantine period.

A small auxiliary enclosure that provides all the environmental needs for the animal is preferable for quarantine. Treatment often requires elevating the ambient temperature and humidity within the enclosure, and a smaller enclosure permits easier maintenance of a constant temperature and a larger water bowl can be used to increase humidity through evaporation in the heated environment. The use of an auxiliary enclosure also prevents internal and external parasites and bacteria from contaminating the main enclosure, and it is best constructed of a material that is easy to clean and disinfect. Disinfecting agents containing peroxide or alcohol should be used to clean habitats and equipment. Under no circumstances should products containing phenols or other toxic agents be used. The enclosure should be void of all non-essentials items, containing only food and water bowls and an absorbent material for waste management. Bowls should be washed with antibacterial soap and thoroughly rinsed

Sandblasted wood branches and some artificial plants keep a display from looking bare. This enclosure uses commercial plastic paneling that facilitates cleaning and adds a level of thermal insulation. All seams are sealed to minimize problems with ants and other insects. The window is UV-transmittable glass, providing a substantial amount of natural sunlight during the day. The vent at the top extracts air from the enclosure with a fan to help minimize odor and draw fresh air into the enclosure through vents at the bottom. An additional heat-lamp that was installed for the winter months is barely visible at the top of the window. *Photograph by John Binns.*

with fresh water after each use. Waste from the animal should be removed immediately and clean substrate provided.

Healthy Spiny-tailed Iguanas typically exhibit lively and inquisitive behaviors. During the active phase (daytime), the animals eat, threaten, court, or patrol their territory with alternating periods of basking or sleeping. Sick animals, on the other hand, will have sunken eyes and protruding pelvic bones due to loss of weight, and lack muscle on the legs and tail. They tend to lie apathetically at the bottom of the enclosure and do not react to their surroundings. Any movements tend to be halting and insecure and the lower abdomen often rests on the ground.

The importance of regular observation cannot be overemphasized. Behavioral changes could indicate illness or other problems for which treatment should be sought and administered immediately. Animals in the wild will instinctively conceal signs of illness to avoid attracting predators, reinforcing the need for careful observation.

Distinguishing the Sexes

In fully-grown males of most ctenosaur species, the dorsal crest is substantially more developed than in females. Exceptions are *C. alfredschmidti*, *C. clarki*, *C. defensor*, and *C. flavidorsalis*, in which neither males nor females have particularly well-developed dorsal crests. Adult males also usually have clearly visible hemipenial bulges under the base of the tail. Another important character for determining gender is the size of the femoral pores, which are always larger in males than in females. In adult male *C. similis*, the femoral pores can attain diameters of 2.5 mm, whereas they are rarely more than 1 mm in diameter in females.

Housing

The size of the enclosure will determine the degree of flexibility in design and setup. Planning must include provisions for animal barrier isolation and for developing lighting and temperature zoning for thermoregulation. In order to adequately provide for a complete behavioral repertoire, a ctenosaur enclosure must be large and sturdy. For an adult pair of any of the medium-sized or large species (subgenera *Ctenosaura* and *Loganiosaura*; see Köhler et al., *IGUANA* 10(3):79–81), a habitat should be at least 200 x 150 x 130 cm. For the smaller species (subgenus *Enyaliosaurus*), the minimum size would be 80 x 60 x 90 cm. As is the case with all medium-sized to large iguanas, space planning for adult sized animals is critical when initially considering the enclosure design. If the animals have been previously paired and are able to comfortably co-exist, the recommended enclosure size should be sufficient. However, if a male and female are purchased individually and are subadults or older, a second enclosure should be available in cases of incompatibility.

Hatchling Spiny-tailed Iguanas are best housed in groups of three or four in at least a medium-sized terrarium about 60 x 40 x 60 cm in size. Certain juveniles in captivity, like their counterparts in the wild, can be distinct loners and may be incompatible with other individuals. A well-structured terrarium with multiple basking spots and hiding places is required for raising juveniles together. Sometimes, however, despite all these measures, combatants must be separated to avoid injuries.

Setup

Because Spiny-tailed Iguanas are territorial, the habitat should be structured to permit animals to avoid one another, particularly if individuals vary in size. Visual barriers and hiding places can be created using rocks, tree roots, corrugated-drain tubing, cork tubes, or whole pieces of cork bark attached to walls. All structures and components need to be sufficiently secured and stable to prevent damage to the component or injury to the iguanas.

Isolation barriers may necessitate the provision of individual basking areas, and this should be considered when developing the enclosure design. Basking locations should be designed to incorporate a declining temperature zone for proper thermoregulation. This entails creating a surface that allows the animal to adjust its position relative to the central "hotspot" (high temperature areas) in order to maintain the correct body tem-

This female *Ctenosaura acanthura* will climb on her log to bask under UV lamps and comfortably wedge herself inside it to sleep at night. *Photograph by Carole Saucier.*

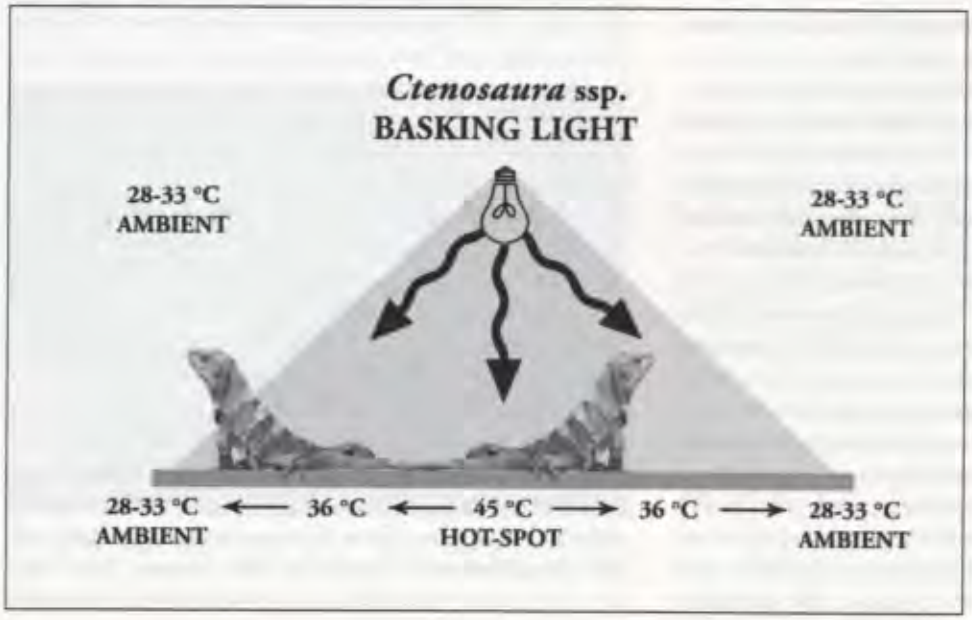
perature. In the wild, animals can maintain body temperature within a few degrees by repositioning themselves between bright sun and shade or retreating into cooler burrows. Providing temperature zones is a mandatory habitat design element to ensure good health. Since iguanas require heat to effectively digest food, inadequate thermal design of the enclosure will limit the benefits of providing a healthy nutritional diet, even with the presence of sufficient ultraviolet (UV or UVA/B) light.

In areas other than hotspots, the use of artificial rock can appear very natural and has the advantage of being light and relatively easy to clean. Artificial rock or structures can be purchased from most large pet suppliers. As an alternative for those who prefer a more "natural" setting, artificial props such as rock can be constructed. The base material of an artificial rock or prop can be made from styrofoam blocks, which are easily carved into shape with a hot knife or carving tool. The entire surface can then be covered with plaster mixed with a naturally colored powder and then modeled appropriately with a wet brush. Sharp edges should always be avoided. While still damp, the plaster can be covered with sifted sand to give the appearance of sandstone or left bare to represent some other natural rock. Covering the structure with sand helps reduce sharp edges, but it also makes cleaning more laborious and should be used only in areas unlikely to become soiled. The use of any potentially toxic or petroleum-based materials in the construction of props must be avoided.

Each component used in the enclosure should be cleaned or washed prior to use or assembly. Additionally, if the enclosure is located where insects, ants, parasites, and other undesirables might invade, some provision for preventative maintenance should be considered. Elaborate, natural-appearing habitats can be extremely difficult to rid of pests, often requiring complete disassembly to solve the problem. A preventative measure to consider during the design phase, especially if ants are a recurring problem, is construction of the enclosure so that it is elevated off the ground and the structure's waterproofed support beams fitted into a water reservoir to create an isolation barrier. Ants are of particular concern during the egg-laying season.

Sanitized driftwood or tree-limb sections obtained commercially combined with artificial plants are excellent enclosure components for providing physical isolation, and will allow animals to move from one level to another while making effective use of the three-dimensional space. Combined with artificial or natural rocks, these can produce a very naturalistic environment and simultaneously provide for the needs of the iguanas.

An inexpensive alternative to burrow construction is black plastic corrugated drain tubing, which is available in various diameters. The corrugated tubing also is useful when handling more intransigent animals. If this tubing is employed as the primary "burrow" or "hiding chamber," the animal will readily accept it and use the tube as a secure hiding location or as a sleep chamber. Once the animal is in the tube, both ends can be covered by a gloved hand, and the animal can be easily and safely transported to another location or holding pen. This method is extremely useful in transporting excitable or unruly animals from the main enclosure to an outside cage for sunlight exposure. Once the sun goes down, the animal retreats naturally to



Gradient temperature zoning is necessary for proper thermoregulation. The iguana under the basking lamp enjoys a temperature ranging from 45–36 °C, whereas the iguana on the left is exposed to a temperature ranging from 36 °C to ambient enclosure temperatures of 28–33 °C. The thermal-spread from the basking lamp to the enclosure's floor (indicated by the light gray triangle) is controlled by adjusting the height and/or wattage of the lamp. Basking lamps should have reflectors and protective screens. *Illustration by John Binns.*

Inexpensive corrugated drain tubing comes in various sizes and can be used for burrows and retreats. Tubing helps reduce territorial disputes by providing ample hiding places and allowing each individual to take ownership of a tube. *Photograph by John Binns.*

A well-secured Spiny-tailed Iguana (*Ctenosaura nolascensis*), safely buried in his "burrow," makes for easy transportation. *Photograph by John Binns.*

Corrugated drain tubing can be used to transport aggressive Spiny-tailed Iguanas. The tube provides a sense of security, minimizing stress for the iguana, and, most importantly, reducing the chances of getting bit (note the use of heavy gloves). *Photograph by John Binns.*

Corrugated drain tubing distributed around the enclosure provides protection from a dominant animal and serves to visually isolate individuals. The tubing can be placed under or behind an enclosure's artificial props to enhance the aesthetics of a "natural" setting. *Photograph by John Binns.*

its "tube," and it can then be transported back to the main enclosure with minimal disturbance and stress.

Cork tubes also make good habitat furnishings. They provide iguanas with traction for climbing and are readily accepted as sleeping places. For smaller species, the enclosure can be attractively decorated with *Yucca* and other robust plants. Enclosures for juveniles also should include plants, as these help retain humidity. For adults of the larger species (e.g., *C. similis, C. melanosterna*), plants only make sense if the habitat is large enough to ensure that they are out of the iguanas' reach. Otherwise, the plants will be either eaten or trampled in very short order. Artificial plants are a hardier and still attractive alternative.

A food bowl can simply be placed on the bottom of the enclosure. The use of commercially available garden cement tiles or walkway liners that keep the bowls from being upset will aid in housekeeping. Some animals, however, will not readily descend from an elevated perch, and are much more likely to eat if their food is placed higher. Driftwood structures can be used to construct a secondary platform higher in the enclosure. Although adult Spiny-tailed Iguanas normally meet all of their fluid requirements from the food that they eat, a water bowl should always be provided — and cleaned daily. In cases where territorial disputes occur, assuming the disputes do not result in injury, separate food bowls and water dishes can be used to minimize conflict.

A mixture of sanitized soil, sand, and cypress bark mulch comprises an appropriate substrate when simulating a natural environment. The use of unprocessed soil, sand, and bark mulch is not recommended due to the potential of introducing insects, bacteria, or other undesirable elements. For those concerned about maintenance, the use of artificial turf can be employed with minimal impact on the natural appearance of the enclosure. In essence, once the enclosure props are established, artificial turf floor inserts can be constructed and used as substrate pads. These can be secured using snaps, Velcro©, or quick-release locking devices. The artificial turf pads can be duplicated and replaced for ease of cleaning and maintenance. Wood shavings, corn based substrates, and newspaper are not recom-

A young *Ctenosaura similis* peeking out of a cork tube. Cork tubes provide iguanas with traction for climbing and are readily accepted as hiding and sleeping places. *Photograph by Gunther Köhler.*

Cement garden tiles or walkway borders, which are useful for securing food dishes, also may serve decorative purposes. These cement pieces are lighter than natural stone and allow considerable flexibility when designing an aesthetically pleasing enclosure. *Photograph by John Binns.*

This male *Ctenosaura flavidorsalis* was much more inclined to feed regularly when the food dish was secured in an elevated position. *Photograph by Gunther Köhler.*

mended; they are impractical and lack aesthetic appeal. Wood shavings can be accidentally ingested and can result in life-threatening intestinal impaction.

Hatchling terraria should be furnished with branches, a plant, small roots, several tubes of cork or corrugated plastic, a water dish (10–15 cm in diameter, water temperature 25–30 °C), and a heat emitter (80 W) and fluorescent tube for heat and light. A heating mat may be used to warm the water bowl from below. Hatchlings have a much higher fluid requirement than adult iguanas and should be provided with sufficient drinking water. Water bowls should be cleaned and filled daily and the terrarium misted regularly.

Heat and Light Requirements

Spiny-tailed Iguanas will be fully active and can display their intense coloration only with proper illumination. The daily photoperiod (light time) will vary by season and according to the geographic origin of the species. Regulating a consistent photoperiod as well as appropriate daily temperature fluctuations in the enclosures is recommended. To simulate the 24-hour cycle, the method of controlling light and heat should be considered prior to setting up the enclosure. Many commercially available "timers" can individually control lights and thermostats used to control the heat source, or more sophisticated electronic controllers are capable of simulating a complete 24-hour cycle (light and heat) from sunrise to sunset. Whichever method is used, installation will require careful planning. Specifics are variable, depending on the type of light and heat sources, power requirements, reliability, costs, and aesthetic considerations.

Light can be broken down into three basic categories: (1) ultraviolet or UVA/B light is required for iguanas to produce vitamin D3 (see also Bogoslavsky, *Iguana Times* 9(1–2):32–34 and MacCargar, *IGUANA* 10(3):82–85), (2) visible light reflects the combined color spectrum that collectively produces white or full-spectrum light, and (3) infrared light, which is essentially heat and is invisible to the human eye. A current trend is to combine the UVA/B and visible light spectra, and this has been successful to some degree. The types of artificial lighting available for purchase vary depending on location, and the charts provided in this article feature some of the products available in the United States. Although many products are readily available, *Ctenosaura* (and other iguanas) require higher levels of UVA/B than most other reptiles; therefore, the products selected should include lamps that produce sufficient quantities of light in the UV range. Regular ultraviolet (UV) light is critical for proper calcium metabolism and breeding.

The selection of lighting itself is complex and often confusing. Aside from determining which type of bulb to use, questions regarding fixture types, location, and mounting must be addressed. With effective planning, the various requirements (lamp types) for proper illumination can be minimized. Factors to consider in planning for proper illumination include locating the UVA/B lamp within its effective range relative to where the animal is likely to spend the greatest amount of time, the location of full spectrum lighting to best provide overall illumination of the enclosure, and basking spot lamp location or locations that facilitate the temperature zone concept mentioned previously.

This elaborate electronic habitat control system automatically controls 32 enclosures; two of those electronic control units are shown in the photograph. This system controls the lighting to simulate sunrise by slowly increasing to full intensity. Then, at a selected time, simulates sunset by slowly decreasing intensity until dark, at which time simulated moonlight is activated. The system also controls ambient temperatures that correspond to day and evening settings. Should any of the presettings fail or exceed limits, an audible alarm is activated and an auto-dialer sends a message to a beeper. A muffin-fan is activated if the enclosure overheats. All the lamps are turned off until the ambient temperature reaches safe levels. *Photograph by John Binns.*

This custom light fixture employs UV, full spectrum, and heat lamps (including a "moon" light). Custom fixtures help reduce unsightly wiring, adjustable reflectors, and screened protection for the animal. This fixture uses electrical conduit to eliminate exposed wiring. *Photograph by John Binns.*

Large outside cages on rollers are an excellent means of providing "natural" basking sites. Cages can be repositioned easily in sun or shade and the relatively large size allows an animal to reposition itself for the most effective thermoregulation. The black foam floor mat that takes up about half the shelf collects heat to provide a hot spot. The other half of the shelf is wire-mesh and is much cooler. During the summer months, a portion of the top of the cage is covered to provide shade. *Photograph by John Binns.*

Mounting of lamps is not restricted to the ceiling of the enclosure, which in very large enclosures would require lamps of very high wattage in order to be effective at floor level. To reduce the overall power requirements (wattage) of each lamp, suspension is an effective method. Suspension also enables height adjustments to fine-tune heat and UV delivery. Naturally, precautions must be taken to prevent animals from coming into contact with suspended fixtures and to ensure that all heat-producing sources have protective screening. Essentially, lower wattage UV and basking lamps can be located closer to the floor, whereas general full-spectrum illumination is mounted high in the enclosure. In some cases, the use of a single, high-power full-spectrum lamp such as sodium, mercury or metal-halide lamps in the 250-watt range is less costly than employing four 100-watt full-spectrum lamps dispersed around the ceiling of the enclosure.

Precisely calculating the proper lamp wattage can be difficult, especially if the enclosure has a complex layout. One alternative is to first select lamps of various wattages and, through testing, discover the right combination to produce the desired effect. Changing the wattage of lamps may be required to compensate for changes in ambient temperature or seasonal variations. For most types of lamps, wattage effectively translates into the ability to produce heat. However, in UVA/B lamps, wattage

ULTRAVIOLET OPTIONS

Mercury Vapor Bulbs and Fluorescent Tubes

Mercury Vapor Lamps emit a higher intensity of UVB with added benefits of UVA and full-spectrum light that help the animal produce vitamin D3 to aid in balanced calcium metabolism. All lamps are rated for use at distances from 30 cm to about 2 m. The optimum distance is about 1 m from the bulb lens. These bulbs do emit a fair amount of heat, but less heat than an incandescent bulb of comparable wattage.

Manufacturer	Brand Name	100 Watt Flood	160 Watt Flood	250–275Watt Flood	100 Watt Spot	160 Watt Spot
Zoo Med	PowerSun UV	PUV-11	PUV-10	—	—	—
T-Rex	Active UV	82404	82406	82408 (275w)	82414	82416
Full Spectrum Solutions	R40 Frosted	FSUV100	FSUV160	FSUV250	—	—
Premium Life	Mercury Vapor Globe	PI12000	PI12001	—	—	—

Fluorescent Tubes emit UVB with added benefits of UVA and full-spectrum light with very little heat. About 5–8% of the total energy output is in the UVB wavelengths, which helps to prevent metabolic bone diseases. Fluorescent tubes should be used with an incandescent (day or night) supplement to create an acceptable thermal gradient. All lamps are rated for use at distances from 25–30 cm. The optimum distance is 15–25 cm from the tube.

Manufacturer	Brand Name	14 Watt, 15" Tube	15 Watt, 18" Tube	20 Watt, 24" Tube	30 Watt, 36" Tube	40 Watt, 42" Tube	40 Watt, 48" Tube
Zoo Med	Iguana Light 5.0	FI-15	FI-18	FI-24	FI-36	—	FI-48
Hagen	Exo Terra Repti-Glo 5.0	PT-2159	PT-2160	PT-2161	PT-2163	PT-2164	PT-2165
Hagen	Exo Terra Repti- Glo 8.0	PT-2169	PT-2170	PT-2170	PT-2173	PT-2174	PT-2175
ESU	Reptile Desert 7% UVB	—	RP393	RP390	RP391	—	RP392
ESU	Super UV (3%UVB + 7%UVA)	RP454	RP453	RP450	RP451	—	RP452
Vita-Lite (also has 75w, 96" tubes)	—	—	VL-06402	VL-3028	VL-1064	—	VL-06418

can be misleading relative to their ability to produce heat, which is significantly less than a comparable visible spectrum lamp of the same wattage.

Selection of lamp type should be based on performance, longevity, and aspects of enclosure design such as size, shape, and materials (hard-walls, wire-screen, etc.) used. In general, as the size of the enclosure increases, so does the requirement for light and heat (wattage). For small indoor enclosures, in which ambient temperatures remain relatively constant, the amount of heat produced in lamps must be checked and allowances made for adequate air-ventilation to prevent the enclosure from overheating. Conversely, maintaining temperatures within allowable limits within a screened enclosure located in an area that is subject to large ambient temperature fluctuations can prove to be a challenge. This situation often leads to the use of additional heat sources and controllers to compensate for temperature variations.

As a final word on illumination, no light supplement for captive animals is better than natural sunlight. Regular periods of exposure, when possible, should be employed. In designing enclosures, any access to natural sunlight (window, porch, skylight, etc.) should be optimized. To utilize the sun's UV, glass and plastics need to be replaced with UV-transmittable substitutes.

Ambient temperatures in an enclosure should range from 28–33 °C during the day and be reduced to 18–24 °C at night. Heat can be generated by the lamps illuminating the enclosure as well as by specific heat producing lamps or ceramic heaters. During the peak summer season, the total illumination wattage may need to be reduced in order to keep the enclosure within

VISIBLE LIGHT OPTIONS (INCANDESCENT DAYLIGHT)

Daylight Blue and Basking Spot Bulbs

Incandescent bulbs emit full-spectrum light, limited UVA, and an abundance of heat. Flood lamps create a larger heated area and spot bulbs create a more concentrated heated area.

Flood Bulbs

Manufacturer	Brand Name	40 Watt	60 Watt	100 Watt	150 Watt
Zoo Med	Daylight Blue	DB-40	DB-60	DB-100	DB-150
T-Rex	Day Blue	TR82322	TR82330	TR82332	TR82334
Hagen	Day-Glo	PT-2104	PT-2110	PT-2112	PT-2114
Hagen	Exo Terra Sun Glo			PT-2111	
ESU	Brightlight	RP409	RP410	RP411	RP150

Spot Bulbs

Manufacturer	Brand Name	50–60 Watt	75 Watt	100 Watt	150 Watt
Zoo Med	Repti Basking	SL-50	SL-75	SL-100	SL-150
Zoo Med	Repti Halogen	HB-50	HB-75	HB-100	HB-150
T-Rex	Basking Clear	TR82390	TR82394	TR82396	
T-Rex	Daylight Blue	TR82360	TR82362	TR82364	TR82366
Hagen	Exo Terra Sun Glo Basking	PT-2131	PT-2132	PT-2133	PT-2134
Hagen	Day-Glo Basking	PT-2135	PT-2136	PT-2138	PT-2140
ESU	Reptile Brightlight Spot	RP413		RP414	RP415
Vita-Lite	Basking Spot	DL4644		DL4647	

allowable temperature limits. If using lower wattage bulbs, providing increased ventilation, and eliminating other sources of heat proves ineffective, air-conditioning may be necessary.

Air conditioning was necessary in this vivarium to solve the problem of overheating during the summer months. This particular vivarium houses a variety of species, each with specific ambient temperature requirements that could not be solved by lowering lamp wattage. The skylight above the compact air conditioner brightly illuminates the inside of the vivarium during daylight hours. *Photograph by John Binns.*

The central zone of the main basking area should have a hotspot reaching 45 °C. This can be produced using a single lamp source or combination of lamps such as spotlights, infrared lights, ceramic heaters, and UV lights, depending again on the particular design of the available lamps and the nature of the enclosure. Further considerations must include a declining temperature zone on an approximately level plane from the central hotspot to the ambient enclosure temperature of about 28–33 °C. Although possibly restricted by limited space, the more gradual the decline in temperature, the more latitude the iguana will have in selecting the proper temperature zone. The temperature gradient can be established by adjusting the height of the basking spot lamp or lamps. Raising and lowering the basking lamps may require a change in wattage to produce the desired temperature. The use of other basking spots can be incorporated at higher levels of the enclosure, but these do not need to be as finely tuned as the main basking spot.

For most species, the relative humidity during the day should be about 50–60%, climbing to 70–80% at night. For particularly low humidity locations, a plastic tub filled with water can be used to increase humidity by evaporation. During the rainy season (May to November), depending on the ambient humidity where you live, the entire habitat should be thor-

INFRARED (INCANDESCENT LIGHT AND HEAT) EMITTERS

Incandescent night bulbs emit low levels of visible light in both flood and spot lamps (red and black glass). Infrared bulbs and ceramic heat emitters are appropriate for nighttime use, as they generate radiant heat and little or no light.

Flood Bulbs

Manufacturer	Brand Name	40 Watt	50–60 Watt	75 Watt	100Watt	150 Watt
Zoo Med	Nightlight Red	NR-40	NR-60	—	NR-100	—
T-Rex	Nocturnal Black	TR82326	—	TR82340	TR82342	TR82344
Hagen	Night-Glo	—	PT-2141	PT-2142	PT-2144	PT-2146
ESU	Nightlight bulb	RP419	—	RP 420	RP 421	RP 422
ESU	Red Basking Night	—	RP 402 (50 Watt)	RP	403 RP	404

Spot, Infrared, and Ceramic Bulbs

Manufacturer	Brand Name	50 Watt	60 Watt	75 Watt	100 Watt	150 Watt
Zoo Med	Infrared	RS-50	—	RS-75	RS-100	RS-150
T-Rex	Day/Night Red	TR82380	—	TR82382	TR82384	TR82386
T-Rex	Nocturnal Black	TR82370	—	TR82372	—	—
ESU	Nightlight Spot	—	RP 423	—	RP 424	RP 425

Ceramic Heat Emitters

Manufacturer	Brand Name	40 Watt	60 Watt	80 Watt	100 Watt	150–165 Watt	215 Watt	250–265 Watt
Zoo Med	Repticare		CE-60		CE-100	CE-150		CE-250
ESU	Bask N' Heat	RP480	RP481	RP482	RP483	RP484	RP485	RP486
Hagen	Exo Terra Heat	PT-2040	PT-2045		PT-2046	PT-2047		

oughly misted at least once a day to simulate rainfall. Enclosure components should be able to withstand misting and electrical components should be avoided. During the dry season, misting two or three times each month is sufficient. *Ctenosaura bakeri* is an exception and has some very specialized care requirements, as their natural habitat is wet mangrove swamp (see, for example, Gutsche, *IGUANA* 10(2):28–29).

This large Rhinoceros Iguana (*Cyclura cornuta*) takes full advantage of the UV and heat lamps overhead. The "lizard hut" is used to facilitate basking close to the lamps and also provides a sleeping site. *Photograph by John Binns.*

Population Density and Socialization

Adult males cannot be kept together. They are territorial and are likely to injure each other. A single male with one or two females can be housed together. Incompatibility and biting is sometimes observed even between females, and separating them into individual enclosures may be unavoidable. Juveniles of the larger species tend to be particularly quarrelsome. Usually, one individual will quickly assume the dominant position and begin to oppress the other lizards. In order to ensure that all animals thrive, any that are repeatedly chased away from food and basking spots must be separated. Juveniles should never be held with adults, as they may be regarded as prey.

The larger species of ctenosaurs can be kept with Green Iguanas or Tegus (*Tupinambis teguixin*). The smaller species, such as *C. clarki* or *C. defensor*, can be kept with Chuckwallas (*Sauromalus*) or the larger species of Spiny Lizards (*Sceloporus*).

Ctenosaura bakeri exhibit at the Frankfurt Zoological Garden illustrates the complexity necessary to house a breeding group of Spiny-tailed Iguanas in a single enclosure. Note also the large "pond," necessary for maintaining the high humidity critical to these mangrove swamp-dwelling lizards. *Photograph by Gunther Köhler.*

This juvenile *Ctenosaura similis* is eating an hibiscus flower. Like many other iguanid lizards, Spiny-tailed Iguanas respond positively to brightly colored blossoms. These are sometimes effective in inducing an otherwise reluctant eater to feed. *Photograph by Gunther Köhler.*

Unlike Green Iguanas, Spiny-tailed Iguanas are omnivorous. This female *Ctenosaura bakeri* is eating a cricket in the wild on Utila Island, Honduras. *Photograph by Gunther Köhler.*

This captive-bred *Ctenosaura similis* readily accepts a dandelion flower. Supplementing purchased foods with items collected in the yard or garden helps to ensure a varied diet. Note, however, that plants sprayed with pesticides or other lawn chemicals are not suitable for use as food. *Photograph by Gunther Köhler.*

Generally, however, species with different habitat needs or those that may be viewed as potential prey (e.g., smaller lizards) should not be housed with ctenosaurs. Keeping ctenosaurs together with turtles is not recommended, since turtles often pass amoebas (e.g., *Entamoeba invadens*), and an amoebic infection is often difficult to treat in herbivorous lizards.

Closely related species from the same subgenus should not be kept together for breeding purposes, because this may result in unwanted hybridization. Accurately identifying the species one acquires for breeding is vitally important, especially in cases where animals are acquired from different sources. Since *Ctenosaura* is not commonly kept in the private sector, a specialist should be consulted for identification. This can be done through the use of photographs and other transmittable data. The keeper must preclude any chance of hybridization. *Ctenosaura oaxacana* and *C. quinquecarinata* have hybridized in captivity. Even under natural conditions, hybridization is known to occur between individuals from different subgenera, such as *Ctenosaura bakeri* and *C. similis*. However, if hybrid animals resulting from irresponsible breeding enter the pet trade or are passed to other breeders and not identified as hybrids, this would quickly contaminate the species' captive gene pool.

Nutrition

Spiny-tailed Iguanas are omnivorous. Juveniles, however, prefer animal-based foods. Between 40 and 80% of the food consumed by young *C. similis* (SVL around 10 cm) consists of insects. In contrast, adult Spiny-tailed Iguanas are predominantly vegetarian. Vegetables, such as sweet potatoes, squash, and green beans, as well as leafy greens, such as dandelions, collard greens, mustard greens, escarole, and chicory are readily accepted. Various seeds and sprouts (linseed, sunflower, soy beans), flowers (dandelions and hibiscus), and fruit (nectarines, peaches, pears, apples, melon, berries, plums) are good supplements. The colors red and yellow are particularly attractive to Spiny-tailed Iguanas (as they are for many other reptiles), so hibiscus flowers, grated carrots, tomatoes, strawberries, dandelion flowers, and other red or yellow foods are usually consumed greedily and often may be used to convince reluctant eaters to feed.

Food should be offered daily and should always include as much variety as possible (see dietary recommendations for Green Iguanas in Barten, *IGUANA* 10(4):129–141; these generally apply to adult ctenosaurs as well). All food items should be washed, chopped into small pieces, and well mixed. During the summer, leafy garden plants (dandelions, clover, mulberry leaves, raspberry leaves) can comprise a large portion of the diet. During the winter, various leafy cooking greens and sprouts can be substituted. Food remnants should be removed daily and food bowls cleaned thoroughly. Some foods contain harmful substances and should be fed only in very limited amounts. These include oxalates (in rhubarb, sorrel, and spinach), nitrates and saponin (particularly in spinach and comfrey), and goitrogens (in cabbage).

Animal protein should be provided 1–3 times per week. This can include all types of commercially available insects such as crickets, grasshoppers, wax moths and their larvae, meal worms, superworms, and giant cockroaches.

Mineral supplements should be added to food daily. All insects should be dusted with mineral powder before they are offered. In addition, a regular vitamin supplement must be provided. Many vitamin supplements are available commercially, but caution is advised. Overdosing or excessive use of these supplements can result in a number of nutritional disorders. Owners should consult their iguana veterinarian to establish a dietary supplement program. This is especially true when considering fat-soluble vitamins, such as A and D, where overdosing is particularly dangerous.

First foods offered to hatchlings should be wax moths and small crickets. Finely chopped and well-mixed vegetables also should be offered daily, although the little lizards will most likely prefer the insects. Hatchlings should receive a mineral supplement containing calcium. With a poor diet, fast-growing juveniles can develop bone disease such as rickets and fibrous osteodystrophy, which are difficult to treat (see also Gutman, *Iguana Times* 9(1–2):35–37).

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